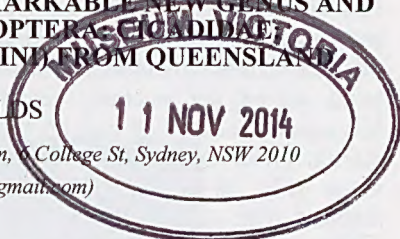


EUTHEMOPSALTRIA LAETA, A REMARKABLE NEW GENUS AND SPECIES OF CICADA (HOMOPTERA: CICADETTINAE: CHLOROCYSTINI) FROM QUEENSLAND

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Abstract

Euthemopsaltria laeta gen. n. et sp. n. is a species with unusual forewing venation showing extreme branching of the median vein that results in many very long parallel veins meeting the ambient vein. In other regards it is typical of the Chlorocystini, with a large inflated male abdomen, a narrow head and leaf-green colouration. Its relationships to other Chlorocystini are discussed and a key to the Australian species of Chlorocystini is provided.

Introduction

The Chlorocystini are a distinctive tribe of mostly green cicadas with narrow heads, the males of which have inflated abdomens and an 'S'-shaped theca (de Boer 1995, Moulds 2012a). In Australia there are currently 14 described species in 9 genera (de Boer 1997, Moulds 2012a, 2012b). The discovery of a rather large and distinctive new species of Chlorocystini in northern Queensland rainforests that showed unusual forewing venation, with extreme branching of the median veins creating many very long parallel veins, was unexpected. This unusual species also represents a new genus and both are described below.

De Boer (1997) provided a key to males of the Australian Chlorocystini. Below I provide an alternative key that incorporates females and the new genus and species described in this paper. Phylogenetic relationships of the new genus and species are also discussed.

Terminology for morphological features and higher classification follows that of Moulds (2005).

Genus *Euthemopsaltria* gen. n.

(Figs 1-12)

Type species: *Euthemopsaltria laeta* sp. n., by present designation.

Diagnosis. Green cicadas of medium size (Figs 1-2). **Head** including eyes narrow, considerably less than mesonotum; supra-antennal plate meeting or nearly meeting eye; postclypeus angulate in transverse cross-section, in lateral profile angulate between 'top' and 'sides'. **Thorax.** Pronotal collar width at dorsal midline narrow, much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth. Cruciform elevation wider than long. Epimeral lobe not reaching operculum. Metanotum partly visible at dorsal midline. **Forewings** (Fig. 4) hyaline with distinct green suffusion; some 20-30 apical cells; a series of approximately 20 subapical cells; ulnar cell 3 substantially parallel to radial cell; basal cell long and

narrow; costal vein (C) clearly higher than R+Sc; costa broadest a little before node; pterostigma absent; vein CuA nearly straight, weakly bowed so that cubital cell no wider than medial cell; veins M and CuA close together at basal cell but not touching; vein CuA₁ divided by crossvein m-cu more or less equally; veins CuP and 1A fused in part; infuscations absent; wing outer margin greatly reduced and virtually contiguous with ambient vein. *Hind wings* (Fig. 5) with approximately 9-11 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end at least twice that of 2nd cubital cell; anal lobe broad with vein 3A curved, long, separated from wing margin; veins RP and M fused basally. *Foreleg* femoral primary spine cylindrical, tending towards lying flat but not quite so. *Male opercula* clearly not meeting, distant from lateral margin of tympanal cavity, directed towards distomedial margin of tympanal cavity, clearly raised above level of tympanal cavity on its outer half; inner margin straight; apically tapering to a blunt point. *Male abdomen* (Fig. 3) markedly inflated, substantially hollow, obtuse; male tergites in cross-section with sides concave, lateroventrally rounded to ventral surface; male tergites 2 and 3 similar in size to tergites 4-7; male sternites 3-7 in cross-section convex. Timbal covers absent. Timbal ribs (Fig. 6) many (approximately 11-13), regular in size and closely spaced filling entire timbal area apart from basal dome; timbals extended below wing bases.

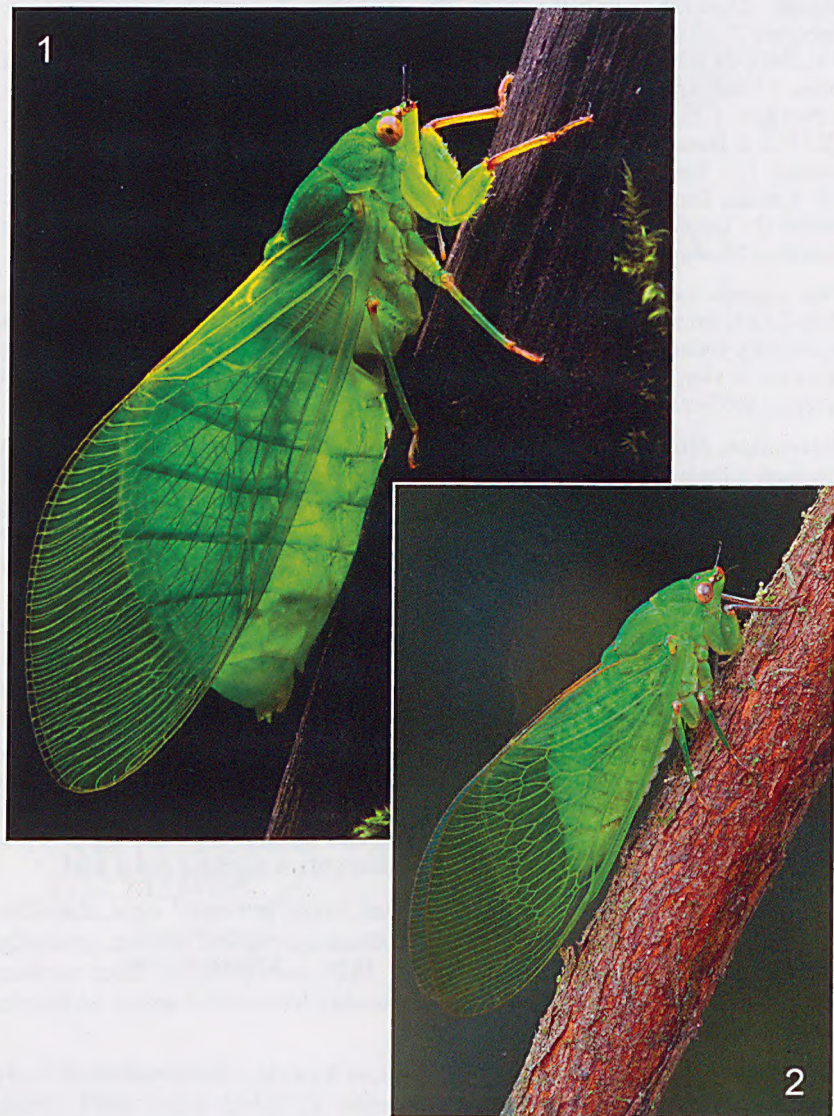
Male genitalia (Figs 7-10). Pygofer with distal shoulder not developed; upper lobe and basal lobe ill-defined, substantially confluent with pygofer margin; dorsal beak present and a part of chitinized pygofer. Uncus undeveloped, globular. Claspers large, dominant, claw-like, restraining aedeagus. Aedeagus with basal plate in lateral view undulated, weakly depressed on dorsal midline; in dorsal view short, tending rounded, apically indented; basal portion of basal plate directed forwards away from thecal shaft; ventral rib completely fused with basal plate; junction between theca and basal plate rigid, without a 'hinge'; thecal shaft barely 'S'-shaped; pseudoparameres absent; thecal apex entirely chitinised, thecal subapical cerci absent; legula absent; conjunctival claws absent; vesica retractable, vesical opening apical on theca. *Male reproductive system* unknown.

Female reproductive system ditrysian; length of accessory glands unknown.

Distinguishing features. Readily distinguished by the forewing venation, which has from 20 to 30 long apical cells and about 15 to 20 subapical cells; also the forewing usually carries a distinct green suffusion, evenly distributed. The hind wing has approximately 9 apical cells. Like many other Chlorocystini the male abdomen is markedly inflated. The head is narrow and considerably less than the width of the mesonotum. The aedeagus lacks appendages.

Included species. *Euthemopsaltria laeta* sp. n. The genus is monotypic.

Etymology. From the Greek *euthemon*, meaning well-arranged or neat and referring to the neatly arranged parallel forewing veins, and from *psaltria*, a traditional ending for cicada generic names probably originating from the Latin meaning a female harpist. Feminine.



Figs 1-2. *Euthemopsaltria laeta* sp. n.: (1) live male, lateral view; (2) live female, lateral view. Photos Stan and Kaisa Breeden.

***Euthemopsaltria laeta* sp. n.**

(Figs 1-12)

Types. *Holotype* ♂, QUEENSLAND: Windsor Tableland, NNW of Mossman, 20.ii.1982, M.S. & B.J. Moulds (in Australian Museum, Sydney). *Paratypes*: 1 ♂, Kuranda, 25.ix.1981, W.N.B. Quick (in Australian National Insect Collection, Canberra); 3 ♂♂, 9 km along Merragallan Rd, WSW of Malanda, 12.v.2003, 23.vi.2003, 21.ii.2004, J. Olive (in collection of J. Olive, Cairns); 1 ♂, near Millaa Millaa, 17.564°S, 145.579°E, 25.iv.2014, B. Hacobian; 1 ♀, Malanda district, v.1998, S. Breeden; 1 ♂, same data as holotype but 16.i.1988; 1 ♀, Windsor Tableland, 5.iii.1992, J. Hasenpusch; 1 ♂, Mt Lewis, iv.1987, J. Mallet; 1 ♀, Kuranda, i.1993, S. Lamond; 1 ♀, Kuranda, 11.iv.1981, G. Wood (in collection of M. Moulds, Kuranda); 1 ♂, Kirrama Range, Douglas Ck Rd, 800 m, 9-12.xii.1986, Monteith, Thompson & Hamlet (in Queensland Museum, Brisbane); 1 ♂, Kuranda, F.P. Dodd (in South Australian Museum, Adelaide).

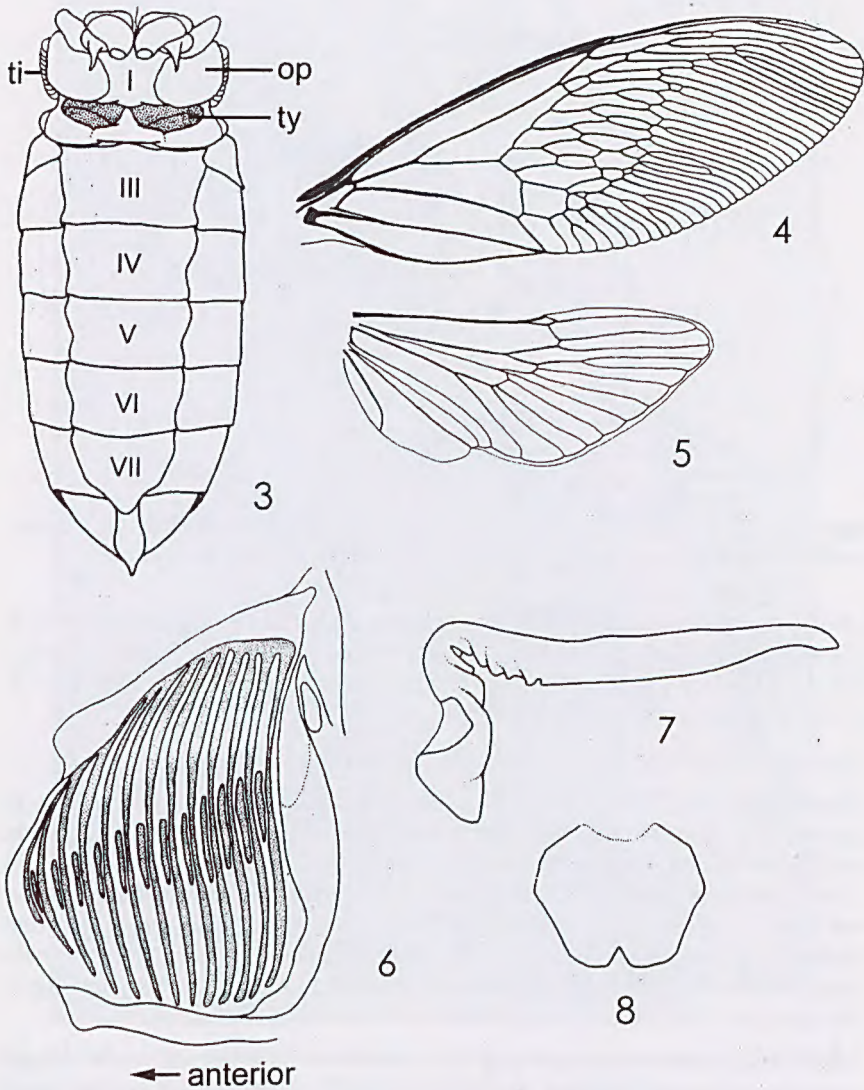
Other material examined. 1 ♂, Mt Glorious State Forest, southeastern Queensland, 25.xii-2.i.87, from *Argyrodendron actinophyllum* [intercept flight trap] by Y. Basset (in author's collection). This specimen is indistinguishable from those of the type series but in view of its locality being so distant from other known localities it might represent another species.

Description. Male. Head, thorax and abdomen primarily uniformly leaf green although a little paler below; underside partly pale pinkish, mainly at base of abdomen and bases of legs. Head with supra-antennal plates and anterior rim of postclypeus brown, tending paler on supra-antennal plates. Eyes of live specimens pale to light brown. Antennal plates and anterior margin of postclypeus brown, glossy. Rostrum reaching to apices of mid coxae. Timbals (Fig. 6) tending whitish with short ribs light brown; with 11-12 long parallel ribs. Forewings uniformly and strongly tinted green; basal membrane pale orange; venation as in Fig. 4 but individually variable in the vicinity of subapical cells and to a small degree in the apical cells; venation green in live specimens except for much of vein 2A+3A, which is brown. Hind wings very weakly tinted green; venation as in Fig. 5 but with some individual variation in the division of apical cells; venation very pale green. Legs green with fore tibiae brown, the joint between tibia and femur on mid and hind legs brown, all tarsi brown or mostly so, all pretarsal claws black on their distal half.

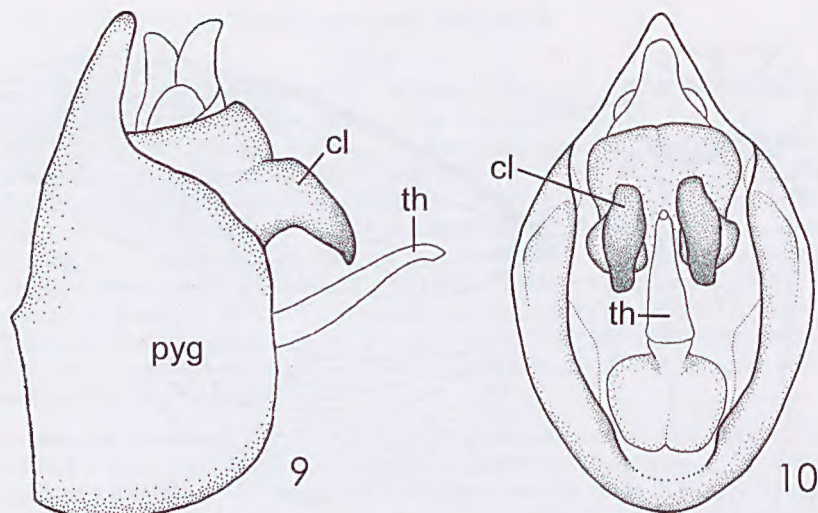
Genitalia (Figs 7-10) with uncal lobes robust, broad in ventral view, claw-like in lateral view. Aedeagus (Figs 7-8) with theca simple and tubular, gradually tapering to apex, basally turned through 180°, convolute on inner surface; basal plate in dorsal view tending to be rounded, indented at apical midline in a V-shape.

Female. Similar to male. Abdominal segment 9 stocky, dorsal midline clearly less than twice the length of that of tergite 8; apical spine small, blunt; ovipositor sheath not longer than abdominal segment 9.

Distinguishing features. See generic description above.



Figs 3-8. *Euthemopsaltria laeta* sp. n., male: (3) abdomen, ventral view; (4) forewing; (5) hind wing; (6) timbal; (7) aedeagus, lateral view; (8) basal plate, dorsal view, apex at bottom. *op* operculum; *ti* timbal; *ty* tympanum; *I-VII* numbered sternites.



Figs 9-10. *Euthemopsaltria laeta* sp. n., male genitalia: (9) lateral view; (10) ventral view with claspers spread apart. *cl* clasper; *pyg* pygofer; *th* theca of aedeagus.

Measurements (mm). $n = 7$ males, 4 females. *Length of body*: male 32.6-34.8 (33.93); female 22.8-23.7 (23.25). *Length of forewing*: male 33.8-35.7 (34.6); female 30.0-35.9 (32.95). *Width of head*: male 5.2-5.6 (5.43); female 5.3-5.6 (5.45). *Width of pronotum*: male 7.8-8.2 (8.03); female 7.1-8.5 (7.8).

Etymology. From the Latin *laetus* meaning joyful, glad, pleasant.

Distribution and habitat (Fig. 11). Northeastern Queensland, where it is known only from the Windsor Tableland, Mount Lewis, Kuranda, Malanda and Millaa Millaa districts and the Kirrama Range. Adults have been taken in all months from December to June and at Malanda can be found throughout the year (J. Olive pers. comm.). It is a locally common species around Malanda, Millaa Millaa and on the Windsor Tableland. A single known male from Mount Glorious State Forest in southeastern Queensland may belong to this species.

Adults usually perch amongst tangled vegetation a little beyond reach and are normally difficult to capture but occasionally they occur near ground level where they are easily taken by hand. The species is found only in primary rainforest where it tends to be locally common.

Song. Males sing at dusk when it is almost dark and continue for some 15-20 minutes. The call is loud, resembles a constant, high-pitched whistle and most likely is a pure tone (*i.e.* resonates at a precise frequency); no recordings are available.

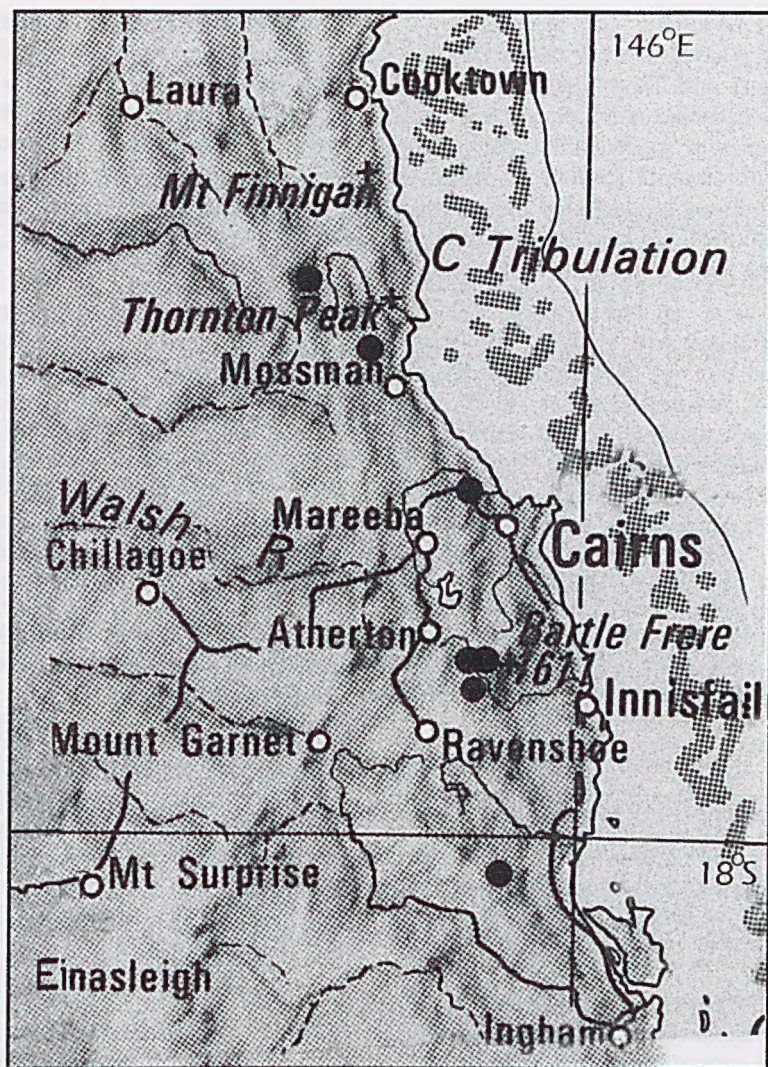


Fig. 11. Map of northeastern Queensland centred around Cairns, showing distribution of *Euthemopsaltria laeta* sp. n.; black dots indicate known localities.

Phylogenetic relationships

To determine the phylogenetic relationships of *Euthemopsaltria laeta* a cladistic analysis was undertaken, using the species of Chlorocystini and relevant characters extracted from the cladistic analysis of Moulds (2005). The species included are the type species of relevant genera [except for *Thaumastopsaltria adipata* (Stål) and *Lembeja maculosa* (Distant), which

were unavailable and replaced by *T. globosa* (Distant) and *L. vitticollis* (Ashton) respectively], to which have been added *Gymnotympana varicolor* (Distant) and *Thaumastopsaltria smithersi* Moulds because they differ in some character states from their congeners. The character descriptions and the matrix of species and their assigned states are given in Table 1, together with minor modifications as stated in the notes below relevant characters. Outgroup choice included those representatives of three genera identified as sister to the Chlorocystini by Moulds, viz. *Lembeja vitticollis*, *Prasia faticina* Stål and *Parnisa designata* (Walker).

Data were analysed using the heuristic search parsimony algorithms implemented with PAUP* version 4.0d100 (Swofford 2003). Tree searches utilised the tree bisection reconnection algorithm (TBR) conducting 1,000 random addition searches (RAS) starting from random trees; other settings were left at their default values. All characters were unweighted and all multistate characters were treated as unordered. Unknown or irrelevant character states have been scored as '?'.

Table 1. Character matrix used in the parsimony analysis (based on that used in Moulds 2005) for Australian Chlorocystini. Missing data and character states unknown are scored as '?'. In the list of character descriptions, character numbers in brackets are those that correspond to those in Moulds (2005) in his larger analysis of cicada relationships. Some character states used by Moulds (2005) were irrelevant to this analysis and states have been renumbered sequentially from zero.

Species	1	11111	11112	2
	12345	67890	12345	67890
<i>Lembeja vitticollis</i> (Ashton, 1912)	00?00	00000	00000	0000? ?
<i>Prasia faticina</i> Stål, 1863	00?00	?0000	10000	0?0?? ?
<i>Parnisa designata</i> (Walker, 1858)	10?01	10101	00010	00??? ?
<i>Chlorocysta vitripennis</i> (Westwood, 1851)	31111	11111	00111	11111 1
<i>Cystopsaltria immaculata</i> Goding & Froggatt, 1904	6???0	?000? 01011	0111?	? ?
<i>Cystosoma saundersii</i> Westwood, 1842	6???0	?000? 01011	01111	0
<i>Euthemopsaltria laeta</i> sp. n.	5131?	11012	02111	1121? ?
<i>Glaucopepsaltria viridis</i> Goding & Froggatt, 1904	41111	11110	00111	1121? ?
<i>Guineapepsaltria flava</i> (Goding & Froggatt, 1904)	00?01	11100	00111	01110 ?
<i>Gymnotympana strepitans</i> (Stål, 1861)	00?01	11100	10211	0111? ?
<i>Gymnotympana varicolor</i> (Distant, 1907)	00?01	11100	10111	0111? ?
<i>Owra insignis</i> Ashton, 1912	21011	11001	00?11	0111? ?
<i>Thaumastopsaltria globosa</i> (Distant, 1897)	30?10	10000	01111	0111? ?
<i>Thaumastopsaltria smithersi</i> Moulds, 2012	30?10	10100	00111	0111? ?
<i>Venustria superba</i> Goding & Froggatt, 1904	10?01	11100	00001	0??1? ?

Characters and character states

1(15). *Forewing apical cell number*: (0) 8 cells; (1) 9 cells; (2) 10 cells; (3) 12 cells; (4) 13 cells; (5) 20 to more than 30 cells; (6) multiple reticulation.

Note: Abnormalities in wing venation are common occurrences. Such abnormalities have been ignored when scoring character states.

2(16). *Forewing subapical cells*: (0) absent; (1) present.

3(17). *Forewing subapical cell number*: (0) 4 cells; (1) approximately 6 cells; (2) approximately 20 cells.

4(18). *Forewing ulnar cell 3*: (0) angled to radial cell; (1) substantially parallel to radial cell.

5(19). *Forewing costa*: (0) reducing or parallel-sided to node; (1) broadest a little before node; (2) with a swollen 'nodule' preceding node.

6(20). *Forewing pterostigma*: (0) present; (1) absent.

7(23). *Forewing vein RA*: (0) aligned closely with subcosta (Sc) for its length; (1) diverging from subcosta (Sc) in subapical region.

8(27). *Forewing outer margin*: (0) greatly reduced and in part contiguous with ambient vein; (1) developed for its total length.

9(29). *Forewing membrane when hyaline*: (0) lacking green tint; (1) with green tint.

10(30). *Hind wing apical cell number*: (0) 6 cells; (1) 4 or 5 cells; (2) 7-10 cells.

11(33). *Hind wing anal lobe*: (0) broad with vein 3A usually strongly curved at distal end, long and separated from wing margin; (1) narrow with vein 3A tending straight, short and usually adjacent to wing margin.

12(35). *Foreleg femoral primary spine*: (0) erect; (1) lying flat, prostrate.

13(38). *Male opercula development*: (0) more or less reaching margin of tympanal cavity (rarely beyond), directed towards distomedial margin of tympanal cavity, apically broadly rounded, not meeting; (1) distant from lateral margin of tympanal cavity, directed towards distomedial margin of tympanal cavity, apically tapering to a blunt point, inner margin straight, clearly not meeting; (2) nearly triangular, strongly cupped, covering and extending beyond tympanal cavity, completely encapsulating meracanthus, not meeting.

Note: The apparent continuity of operculum development makes scoring difficult. Discrete groupings in length and breadth are for the most part lacking and distal and median development appear to be interrelated. For these reasons scoring of the opercula has been limited to identifying groupings exhibiting similar overall shape and size.

14(39). *Male tergites in cross-section*: (0) sides straight or convex; (1) sides partly concave.

15(40). *Male tergites lateroventrally*: (0) epipleurites reflexed to ventral surface; (1) epipleurites rounded to ventral surface.

16(48). *Timbal ribs*: (0) up to seven long ribs; (1) many ribs, at least eight or more.

Note: The character states given here are a refinement upon those given for this character in Moulds (2005) to encompass the diversity within the Chlorocystini.

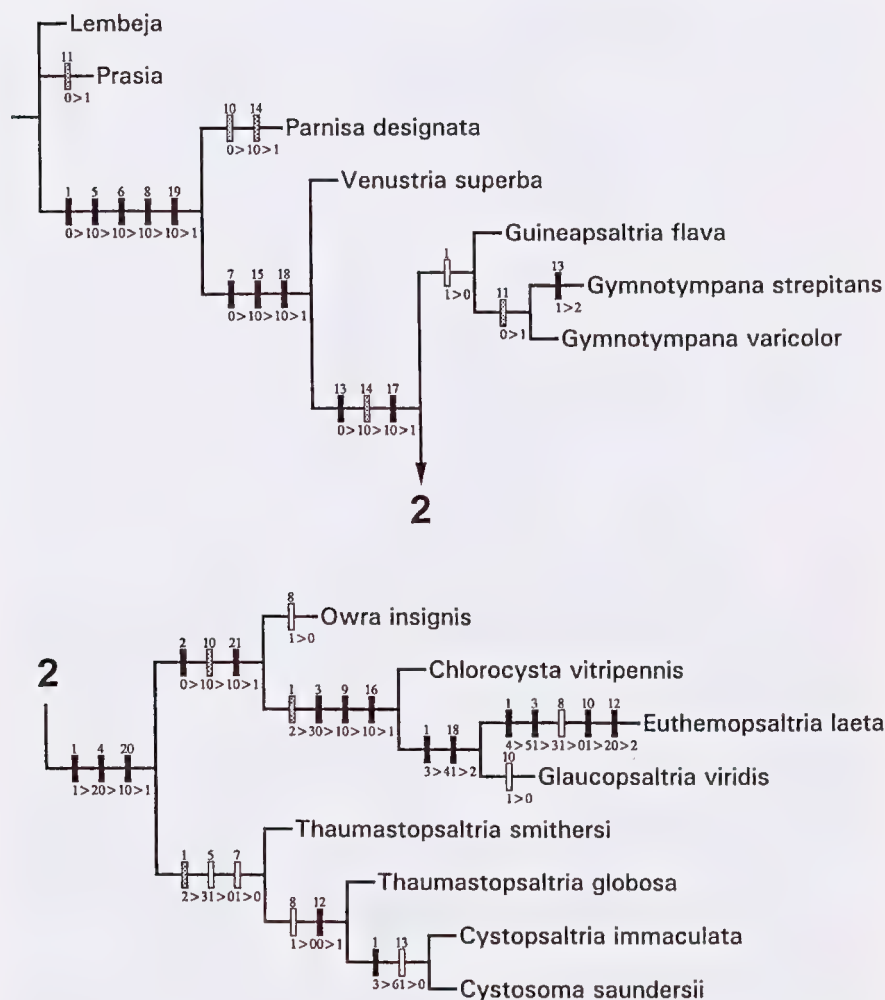


Fig. 12. One of two equally parsimonious trees from a cladistic analysis derived using the procedure described in the text above (length 42, CI 73, RI 78) from an analysis employing *Lembeja vitticollis* as outgroup, with all characters unordered and equally weighted. Numbers at nodes are bootstrap values greater than 50% from 1,000 replications. Character transformations are shown at each node: black bars = non-homoplasious forward change; grey bars = homoplasious forward change; white bars = reversal (whether homoplasious or not).

17(56). *Pygofer upper lobe when thickened*: (0) well developed; (1) small, bud-like, accentuated by adjacent 'dimple' in pygofer.

18(68). *Aedeagal basal plate in dorsal view*: (0) apically broadened with 'ears'; (1) short, broad, usually rounded; (2) short, broad, rounded but apically indented.

Note: State 2 has been added to encompass the diversity within the Chlorocystini not relevant in Moulds (2005). *Parnisa designata* and *Venustria superba* have been scored as '?' because they are unique and unlike any of the other species.

19(73). *Theca in lateral view*: (0) straight or curved in a gentle arc; (1) 'S' shaped or tending so.

20(85). *Accessory glands*: (0) short; (1) long.

21(86). *Accessory glands of common oviduct*: (0) short; (1) long.

Results

Results produced two equally parsimonious trees (length 42, CI 73, RI 78) that differed only in the arrangement of *Guineapsaltria* de Boer and *Gymnotympana* Stål. This small difference had no effect on the placement of *Euthemopsaltria laeta* sp. n., which fell within a well-supported clade together with *Chlorocysta* Westwood, *Glaucopsaltria* Goding & Froggatt and *Owra* Ashton in both trees (see Fig. 12). The grouping of these three genera was also identified by de Boer (1995) in his study of the Chlorocystini using similar characters but different character states. *Euthemopsaltria* gen. n., *Chlorocysta*, *Glaucopsaltria* and *Owra* are unique among the Chlorocystini in having a continuous row of subapical cells in the forewing. Relationships between these four genera place *Owra* as sister to *Chlorocysta*, *Glaucopsaltria* and *Euthemopsaltria*, which share a translucent green tint to the forewing, another attribute unique within the Chlorocystini, and moderately developed male opercula as distinct from the rudimentary opercula of *Owra*. *Euthemopsaltria* is placed sister to *Glaucopsaltria* and supported by two synapomorphies: many apical cells (20 to more than 30) and a short, broad, rounded basal plate that is apically indented.

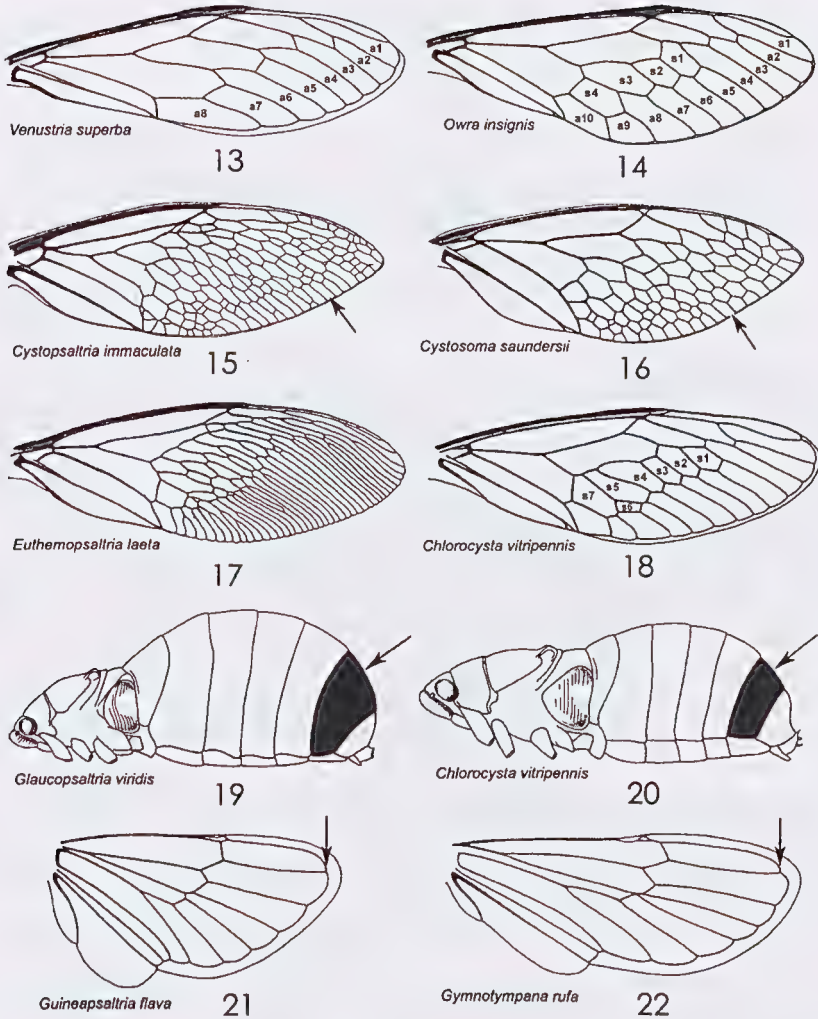
Other genera of Chlorocystini not represented in Australia and not included in the analysis of Moulds (2005), viz. *Aedeastria* de Boer, *Baeturia* Stål, *Mirabilopsaltria* de Boer, *Papuapsaltria* de Boer and *Scottotympana* de Boer, clearly fall outside the clade comprising *Chlorocysta*, *Glaucopsaltria* and *Owra* (de Boer 1995) and consequently are not considered closely related to *Euthemopsaltria*.

Key to described species of Australian Chlorocystini

A number of features used in this key are not clearly visible to the naked eye and examination of specimens at magnification is recommended. Specimens are best viewed with the wings spread and, when there is a choice between sexes, it is usually best to use a male.

1 Forewing with 8 apical cells (Fig. 13) 12

- Forewing with 9 or more apical cells (Figs 14-18) (if one wing has 8 and the other 9, then treat as having 8, not 9) 2
- 2 Forewing hyaline or translucent green 5
- Forewing entirely opaque and coloured green, orange or turquoise 3
- 3 Forewing with majority of marginal cells long and slender, at least three times longer than wide (Fig. 15) *Cystopsaltria immaculata*
- Forewing with only a few marginal cells reaching three times longer than wide, majority much less (Fig. 16) 4
- 4 Forewing 36-54 mm; costa of forewing strongly ampliate near base so that width of ampliate section is about twice that of more distal part *Cystosoma saundersii*
- Forewing 26-36 mm; costa of forewing weakly ampliate near base so that width of ampliate section is only slightly wider than more distal part *Cystosoma schmeltzi*
- 5 Forewing with many apical cells, around 20-30 in number (Fig. 17) *Euthemopsaltria laeta* **gen. n., sp. n.**
- Forewing with 9-15 apical cells 6
- 6 Forewing with a single row of subapical cells (Fig. 14) 7
- Forewing with no subapical cells (Fig. 13) 11
- 7 Forewing with 10 apical cells (sometimes 9 or 11 if aberrant, but usually so only in one wing); 4 or 5 subapical cells (Fig. 14) *Owra insignis*
- Forewing with 12 or more apical cells (sometimes 11 if aberrant, but usually so only in 1 wing); 6 or more subapical cells (Fig. 18) 8
- 8 Male tergite 7 clearly larger than others, its dorsal midline much greater in length (Fig. 19); female normally with 13 apical cells in forewing and 6 apical cells in hind wing (aberrant specimens can have one more or one less in either but usually only in one wing) *Glauropsaltria viridis*
- Male tergite 7 similar in size to others (Fig. 20); female normally with 12 apical cells in forewing and 5 apical cells in hind wing (aberrant specimens can have one more or one less in either but usually so only in one wing) 9
- 9 Plain green cicadas (often yellowish brown in discoloured collection specimens) without markings; males with 9 long timbal ribs *Chlorocysta vitripennis*
- Mottled olive-green cicadas, with dark lateral abdominal markings; males with 11 long timbal ribs 10
- 10 Postclypeus with a brown blotch below *Chlorocysta suffusa*
- Postclypeus lacking a brown blotch below *Chlorocysta fumea*



Figs 13-22. Diagrams accompanying Key to species of Australian Chlorocystini: (13-18) forewings; (19-20) lateral profile of body; (21-22) hind wings.

- 11 Forewing hyaline *Thaumastopsaltria globosa*
- Forewing translucent green *Thaumastopsaltria smithersi*
- 12 Head, thorax and abdomen green (sometimes red), virtually without markings 13
- Head, thorax and abdomen never all green (or red) . . . *Venustria superba*
- 13 Forewing costa red *Gymnotympana rufa*

- Forewing costa green or yellowish green 14
- 14 Male 15
- Female 16
- 15 Abdomen entirely green, yellow or orange below . . . *Guineapsaltria flava*
- Abdomen partly or entirely red below *Gymnotympana varicolor*
- 16 Hind wing apical cell 1 with its distal end as long as, or almost as long as, apical cell 2 (Fig. 21) *Guineapsaltria flava*
- Hind wing apical cell 1 with its distal end clearly shorter than end of apical cell 2 (Fig. 22) *Gymnotympana varicolor*

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